

STRUCTURE            Silicon Monolithic Integrated Circuit  
 TYPE                 Three-Terminal Regulator  
 PRODUCT SERIES    **BA178MXXT**  
 FEATURE             Output current up to 0.5A

○ABSOLUTE MAXIMUM RATING (Ta=25°C)

| Parameter                    | Symbol | Limit             | Unit |
|------------------------------|--------|-------------------|------|
| Input Voltage                | Vin    | 35                | V    |
| Power Dissipation 1          | Pd1    | 2 <sup>*1</sup>   | W    |
| Power Dissipation 2          | Pd2    | 22 <sup>*2</sup>  | W    |
| Output Current               | Iout   | 0.5 <sup>*3</sup> | A    |
| Operating Temperature Range  | Topr   | -40~+85           | °C   |
| Storage Temperature Range    | Tstg   | -55~+150          | °C   |
| Maximum Junction Temperature | Tjmax  | 150               | °C   |

\*1 Derating in done 16mW/°C for temperatures above Ta=25°C  
 \*2 Derating in done 176mW/°C for temperatures above Ta=25°C, Mounted on infinity Aluminium heat sink.  
 \*3 Pd, ASO should not be exceeded.

○RECOMMENDED OPERATING CONDITIONS (Ta=-40~+85°C)

| Parameter      | Symbol | Type      | Min  | Max               | Unit |
|----------------|--------|-----------|------|-------------------|------|
| Input Voltage  | Vin    | BA178M05T | 7.5  | 25                | V    |
|                |        | BA178M06T | 8.5  | 21                |      |
|                |        | BA178M07T | 9.5  | 22                |      |
|                |        | BA178M08T | 10.5 | 23                |      |
|                |        | BA178M09T | 11.5 | 24                |      |
|                |        | BA178M10T | 12.5 | 25                |      |
|                |        | BA178M12T | 15   | 27                |      |
|                |        | BA178M15T | 17.5 | 30                |      |
|                |        | BA178M18T | 21   | 33                |      |
|                |        | BA178M20T | 23   | 33                |      |
|                |        | BA178M24T | 27   | 33                |      |
| Output Current | Io     | Common    | —    | 0.5 <sup>*3</sup> | A    |

The product described in this specification is a strategic product (and/or Service) subject to COCOM regulations.  
 It should not be exported without Authorization from the appropriate government.  
 This product is not designed for protection against radioactive rays.

Status of this document

The Japanese version of this document is the formal specification. A customer may use this translation version only for a reference to help reading the formal version. If there are any differences in translation version of this document, formal version takes priority.

○ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, Ta=25°C, Vin=10V(05), 11V(06), 13V(07), 14V(08), 15V(09), 16V(10), 19V(12), 23V(15), 27V(18), 29V(20), 33V(24), Io=350mA)

| Parameter       | Symbol | Type                | Limit |                            |      | Unit | Condition                    |                              |                            |    |          |
|-----------------|--------|---------------------|-------|----------------------------|------|------|------------------------------|------------------------------|----------------------------|----|----------|
|                 |        |                     | Min.  | Typ.                       | Max. |      |                              |                              |                            |    |          |
| Output Voltage1 | Vo1    | 05                  | 4.8   | 5.0                        | 5.2  | V    | Io=350mA                     |                              |                            |    |          |
|                 |        | 06                  | 5.75  | 6.0                        | 6.25 |      |                              |                              |                            |    |          |
|                 |        | 07                  | 6.7   | 7.0                        | 7.3  |      |                              |                              |                            |    |          |
|                 |        | 08                  | 7.7   | 8.0                        | 8.3  |      |                              |                              |                            |    |          |
|                 |        | 09                  | 8.6   | 9.0                        | 9.4  |      |                              |                              |                            |    |          |
|                 |        | 10                  | 9.6   | 10.0                       | 10.4 |      |                              |                              |                            |    |          |
|                 |        | 12                  | 11.5  | 12.0                       | 12.5 |      |                              |                              |                            |    |          |
|                 |        | 15                  | 14.4  | 15.0                       | 15.6 |      |                              |                              |                            |    |          |
|                 |        | 18                  | 17.3  | 18.0                       | 18.7 |      |                              |                              |                            |    |          |
|                 |        | 20                  | 19.2  | 20.0                       | 20.8 | V    | Io=350mA                     |                              |                            |    |          |
|                 |        | 24                  | 23.0  | 24.0                       | 25.0 |      |                              |                              |                            |    |          |
|                 |        | 05                  | 4.75  | —                          | 5.25 |      |                              | V                            | Vin=7.5~20V, Io=5mA~350mA  |    |          |
|                 |        | 06                  | 5.7   | —                          | 6.3  |      |                              |                              | Vin=8.5~21V, Io=5mA~350mA  |    |          |
|                 |        | 07                  | 6.65  | —                          | 7.35 |      |                              |                              | Vin=9.5~22V, Io=5mA~350mA  |    |          |
|                 |        | 08                  | 7.6   | —                          | 8.4  |      |                              |                              | Vin=10.5~23V, Io=5mA~350mA |    |          |
|                 |        | 09                  | 8.55  | —                          | 9.45 |      |                              |                              | Vin=11.5~24V, Io=5mA~350mA |    |          |
|                 |        | 10                  | 9.5   | —                          | 10.5 |      |                              |                              | Vin=12.5~25V, Io=5mA~350mA |    |          |
|                 |        | 12                  | 11.4  | —                          | 12.6 |      |                              |                              | Vin=15~27V, Io=5mA~350mA   |    |          |
| 15              | 14.25  | —                   | 15.75 | Vin=17.5~30V, Io=5mA~350mA |      |      |                              |                              |                            |    |          |
| 18              | 17.1   | —                   | 18.9  | Vin=21~33V, Io=5mA~350mA   |      |      |                              |                              |                            |    |          |
|                 |        | 20                  | 19.0  | —                          | 21.0 | V    | Vin=23~33V, Io=5mA~350mA     |                              |                            |    |          |
|                 |        | 24                  | 22.8  | —                          | 25.2 |      | Vin=27~33V, Io=5mA~350mA     |                              |                            |    |          |
|                 |        | 05                  | —     | 3                          | 100  |      | mV                           | Vin=7~25V, Io=200mA          |                            |    |          |
|                 |        | 06                  | —     | 3                          | 100  |      |                              | Vin=8~25V, Io=200mA          |                            |    |          |
|                 |        | 07                  | —     | 4                          | 100  |      |                              | Vin=9~25V, Io=200mA          |                            |    |          |
|                 |        | 08                  | —     | 4                          | 100  |      |                              | Vin=10.5~25V, Io=200mA       |                            |    |          |
|                 |        | 09                  | —     | 4                          | 100  |      |                              | Vin=11.5~26V, Io=200mA       |                            |    |          |
|                 |        | 10                  | —     | 5                          | 100  |      |                              | Vin=12.5~28V, Io=200mA       |                            |    |          |
|                 |        | 12                  | —     | 5                          | 100  |      |                              | Vin=14.5~30V, Io=200mA       |                            |    |          |
| 15              | —      | 6                   | 100   | Vin=17.5~30V, Io=200mA     |      |      |                              |                              |                            |    |          |
| 18              | —      | 7                   | 100   | Vin=21~33V, Io=200mA       |      |      |                              |                              |                            |    |          |
|                 |        | 20                  | —     | 8                          | 100  | mV   | Vin=23~33V, Io=200mA         |                              |                            |    |          |
|                 |        | 24                  | —     | 10                         | 100  |      | Vin=27~33V, Io=200mA         |                              |                            |    |          |
|                 |        | 05                  | —     | 1                          | 50   |      | mV                           | Vin=8~12V, Io=200mA          |                            |    |          |
|                 |        | 06                  | —     | 1                          | 50   |      |                              | Vin=9~25V, Io=200mA          |                            |    |          |
|                 |        | 07                  | —     | 1                          | 50   |      |                              | Vin=10~25V, Io=200mA         |                            |    |          |
|                 |        | 08                  | —     | 1                          | 50   |      |                              | Vin=11~25V, Io=200mA         |                            |    |          |
|                 |        | 09                  | —     | 2                          | 50   |      |                              | Vin=12~25V, Io=200mA         |                            |    |          |
|                 |        | 10                  | —     | 2                          | 50   |      |                              | Vin=14~26V, Io=200mA         |                            |    |          |
|                 |        | 12                  | —     | 3                          | 50   |      |                              | Vin=16~30V, Io=200mA         |                            |    |          |
| 15              | —      | 3                   | 50    | Vin=20~30V, Io=200mA       |      |      |                              |                              |                            |    |          |
| 18              | —      | 3                   | 50    | Vin=24~33V, Io=200mA       |      |      |                              |                              |                            |    |          |
|                 |        | 20                  | —     | 4                          | 50   | mV   | Vin=24~33V, Io=200mA         |                              |                            |    |          |
|                 |        | 24                  | —     | 5                          | 50   |      | Vin=28~33V, Io=200mA         |                              |                            |    |          |
|                 |        | 05                  | 62    | 78                         | —    |      | dB                           | ein=1Vrms, f=120Hz, Io=100mA |                            |    |          |
|                 |        | 06                  | 60    | 74                         | —    |      |                              |                              |                            |    |          |
|                 |        | 07                  | 57    | 71                         | —    |      |                              |                              |                            |    |          |
|                 |        | 08                  | 56    | 69                         | —    |      |                              |                              |                            |    |          |
|                 |        | 09                  | 56    | 67                         | —    |      |                              |                              |                            |    |          |
|                 |        | 10                  | 56    | 66                         | —    |      |                              |                              |                            |    |          |
|                 |        | 12                  | 55    | 63                         | —    |      |                              |                              |                            |    |          |
| 15              | 54     | 60                  | —     |                            |      |      |                              |                              |                            |    |          |
| 18              | 53     | 58                  | —     |                            |      |      |                              |                              |                            |    |          |
|                 |        | 20                  | 53    | 58                         | —    | dB   | ein=1Vrms, f=120Hz, Io=100mA |                              |                            |    |          |
|                 |        | 24                  | 50    | 55                         | —    |      |                              |                              |                            |    |          |
|                 |        | 05                  | —     | -1.0                       | —    |      |                              | mV/°C                        | Io=5mA, Tj=0~125°C         |    |          |
|                 |        | 06/07/08/09/10/12   | —     | -0.5                       | —    |      |                              |                              |                            |    |          |
|                 |        | 15/18               | —     | -0.6                       | —    |      |                              |                              |                            |    |          |
|                 |        | 20/24               | —     | -0.7                       | —    |      |                              |                              |                            |    |          |
|                 |        | Peak Output Current | Io-p  | Common                     | —    |      |                              | 875                          | —                          | mA | Tj=25°C  |
|                 |        | Dropout Voltage     | Vd    | Common                     | —    |      |                              | 2.0                          | —                          | V  | Io=500mA |

| Parameter                    | Symbol | Type                 | Limit |      |      | Unit | Condition              |
|------------------------------|--------|----------------------|-------|------|------|------|------------------------|
|                              |        |                      | Min.  | Typ. | Max. |      |                        |
| Load Regulation1             | Reg.L1 | 05                   | —     | 20   | 100  | mV   | Io=5mA~500mA           |
|                              |        | 06                   | —     | 20   | 120  |      |                        |
|                              |        | 07                   | —     | 20   | 140  |      |                        |
|                              |        | 08                   | —     | 20   | 160  |      |                        |
|                              |        | 09                   | —     | 20   | 180  |      |                        |
|                              |        | 10                   | —     | 20   | 200  |      |                        |
|                              |        | 12                   | —     | 20   | 240  |      |                        |
|                              |        | 15                   | —     | 20   | 300  |      |                        |
|                              |        | 18                   | —     | 20   | 360  |      |                        |
|                              |        | 20                   | —     | 20   | 400  |      |                        |
| Load Regulation2             | Reg.L2 | 05                   | —     | 10   | 50   | mV   | Io=5mA~200mA           |
|                              |        | 06                   | —     | 10   | 60   |      |                        |
|                              |        | 07                   | —     | 10   | 70   |      |                        |
|                              |        | 08                   | —     | 10   | 80   |      |                        |
|                              |        | 09                   | —     | 10   | 90   |      |                        |
|                              |        | 10                   | —     | 10   | 100  |      |                        |
|                              |        | 12                   | —     | 10   | 120  |      |                        |
|                              |        | 15                   | —     | 10   | 150  |      |                        |
|                              |        | 18                   | —     | 10   | 180  |      |                        |
|                              |        | 20                   | —     | 10   | 200  |      |                        |
| Output Noise Voltage         | Vn     | 05                   | —     | 40   | —    | μV   | f=10Hz~100kHz          |
|                              |        | 06                   | —     | 60   | —    |      |                        |
|                              |        | 07                   | —     | 70   | —    |      |                        |
|                              |        | 08                   | —     | 80   | —    |      |                        |
|                              |        | 09                   | —     | 90   | —    |      |                        |
|                              |        | 10                   | —     | 100  | —    |      |                        |
|                              |        | 12                   | —     | 110  | —    |      |                        |
|                              |        | 15                   | —     | 130  | —    |      |                        |
|                              |        | 18                   | —     | 140  | —    |      |                        |
|                              |        | 20                   | —     | 150  | —    |      |                        |
| Bias Current                 | Ib     | Common               | —     | 4.5  | 6.0  | mA   | Io=0mA                 |
| Bias Current Change 1        | Ib1    | Common               | —     | —    | 0.5  | mA   | Io=5mA~350mA           |
| Bias Current Change 2        | Ib2    | 05                   | —     | —    | 0.8  | mA   | Vin:8~25V, Io=200mA    |
|                              |        | 06                   | —     | —    | 0.8  |      | Vin:9~25V, Io=200mA    |
|                              |        | 07                   | —     | —    | 0.8  |      | Vin:10~25V, Io=200mA   |
|                              |        | 08                   | —     | —    | 0.8  |      | Vin:10.5~25V, Io=200mA |
|                              |        | 09                   | —     | —    | 0.8  |      | Vin:12~25V, Io=200mA   |
|                              |        | 10                   | —     | —    | 0.8  |      | Vin:13~25V, Io=200mA   |
|                              |        | 12                   | —     | —    | 0.8  |      | Vin:14.5~30V, Io=200mA |
|                              |        | 15                   | —     | —    | 0.8  |      | Vin:17.5~30V, Io=200mA |
|                              |        | 18                   | —     | —    | 0.8  |      | Vin:21~33V, Io=200mA   |
|                              |        | 20                   | —     | —    | 0.8  |      | Vin:23~33V, Io=200mA   |
| Short-Circuit Output Current | Ios    | 05/06/07/08          | —     | 0.4  | —    | A    | Vin=25V                |
|                              |        | 09/10/12/15/18/20/24 | —     | 0.17 | —    |      | Vin=30V                |
| Output Resistance            | Ro     | 05                   | —     | 9    | —    | mΩ   | f=1kHz                 |
|                              |        | 06                   | —     | 10   | —    |      |                        |
|                              |        | 07                   | —     | 11   | —    |      |                        |
|                              |        | 08                   | —     | 12   | —    |      |                        |
|                              |        | 09                   | —     | 13   | —    |      |                        |
|                              |        | 10                   | —     | 14   | —    |      |                        |
|                              |        | 12                   | —     | 16   | —    |      |                        |
|                              |        | 15                   | —     | 19   | —    |      |                        |
|                              |        | 18                   | —     | 22   | —    |      |                        |
|                              |        | 20                   | —     | 25   | —    |      |                        |
| 24                           | —      | 37                   | —     |      |      |      |                        |

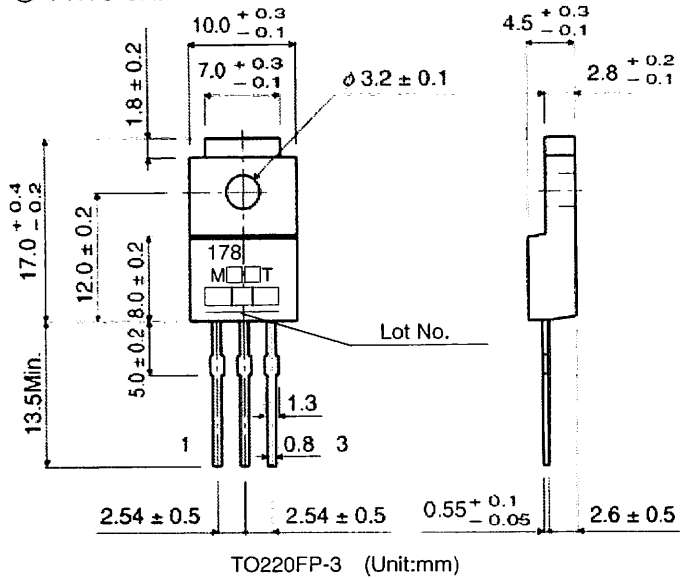
○ Output Voltage and Marking

| Type      | Marking | Output Voltage(V) |
|-----------|---------|-------------------|
| BA178M05T | 178M05T | 5                 |
| BA178M06T | 178M06T | 6                 |
| BA178M07T | 178M07T | 7                 |
| BA178M08T | 178M08T | 8                 |

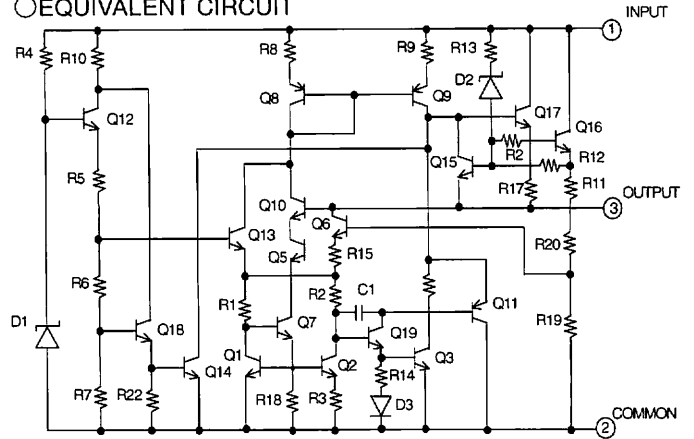
| Type      | Marking | Output Voltage(V) |
|-----------|---------|-------------------|
| BA178M09T | 178M09T | 9                 |
| BA178M10T | 178M10T | 10                |
| BA178M12T | 178M12T | 12                |
| BA178M15T | 178M15T | 15                |

| Type      | Marking | Output Voltage(V) |
|-----------|---------|-------------------|
| BA178M18T | 178M18T | 18                |
| BA178M20T | 178M20T | 20                |
| BA178M24T | 178M24T | 24                |

○ PHYSICAL DIMENTION



○ EQUIVALENT CIRCUIT



○ Pin number, Pin name

| Pin number | Pin name |
|------------|----------|
| 1          | INPUT    |
| 2          | COMMON   |
| 3          | OUTPUT   |

○ NOTES FOR USE

- (1) Absolute maximum range  
We are careful enough for quality control about this IC. So, there is no problem under normal operation, excluding that it exceeds the absolute maximum ratings. However, Absolute Maximum Ratings are those values beyond which the life of a device may be destroyed we cannot be defined the failure mode, such as short mode or open mode. Therefore physical security countermeasure, like fuse, is to be given when a specific mode to be beyond absolute maximum ratings is considered.
- (2) Ground voltage  
Make setting of the potential of the GND terminal so that it will be maintained at the minimum in any operating state. Furthermore, check to be sure no terminals are at a potential lower than the GND voltage including an actual electric transient.
- (3) Thermal design  
When you do the kind of use which exceeds Pd, It may be happened to deteriorating IC original quality such as decrease of electric current ability with chip temperature rise. Do not exceed the power dissipation (Pd) of the package specification rating under actual operation, and please design enough temperature margins.
- (4) Short circuit mode between terminals and wrong mounting  
Do not mount the IC in the wrong direction and be careful about the reverse-connection of the power connector. Moreover, this IC might be destroyed when the dust short the terminals between them or GND.
- (5) Operation in the strong electromagnetic field  
Malfunction may be happened when the device is used in the strong electromagnetic field.
- (6) ASO  
Do not exceed the maximum ASO and the absolute maximum ratings of the output transistor.
- (7) Thermal shutdown circuit  
The thermal shutdown circuit (TSD circuit) is built in this product. When IC chip temperature become higher, the thermal shutdown circuit operates and turns output off. The thermal shutdown circuit, which is aimed at isolating the LSI from thermal runaway as much as possible, is not aimed at the protection or guarantee of the LSI. Therefore, do not continuously use the LSI with this circuit operating or use the LSI assuming its operation.
- (8) GND wiring pattern  
Use separate ground lines for control signals and high current power driver outputs. Because these high current outputs that flows to the wire impedance changes the GND voltage for control signal. Therefore, each ground terminal of IC must be connected at the one point on the set circuit board. As for GND of external parts, it is similar to the above-mentioned.
- (9) Internal circuits could be damaged if there are modes in which the electric potential of the application's input and GND are the opposite of the electric potential of the various outputs. Use of a diode or other such bypass is recommended.
- (10) We recommend to put Diode for protection purpose in case of output pin connected with large load of impedance or reserve current occurred at initial and output off.

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